

# Invasive Spartina Control in Washington State

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*World Class. Face to Face.*

- History and background
- Spartina control and its impacts





**One Year-old Seedling**



**Two Year-old Seedlings**



**Three to Four Year-old Clone**



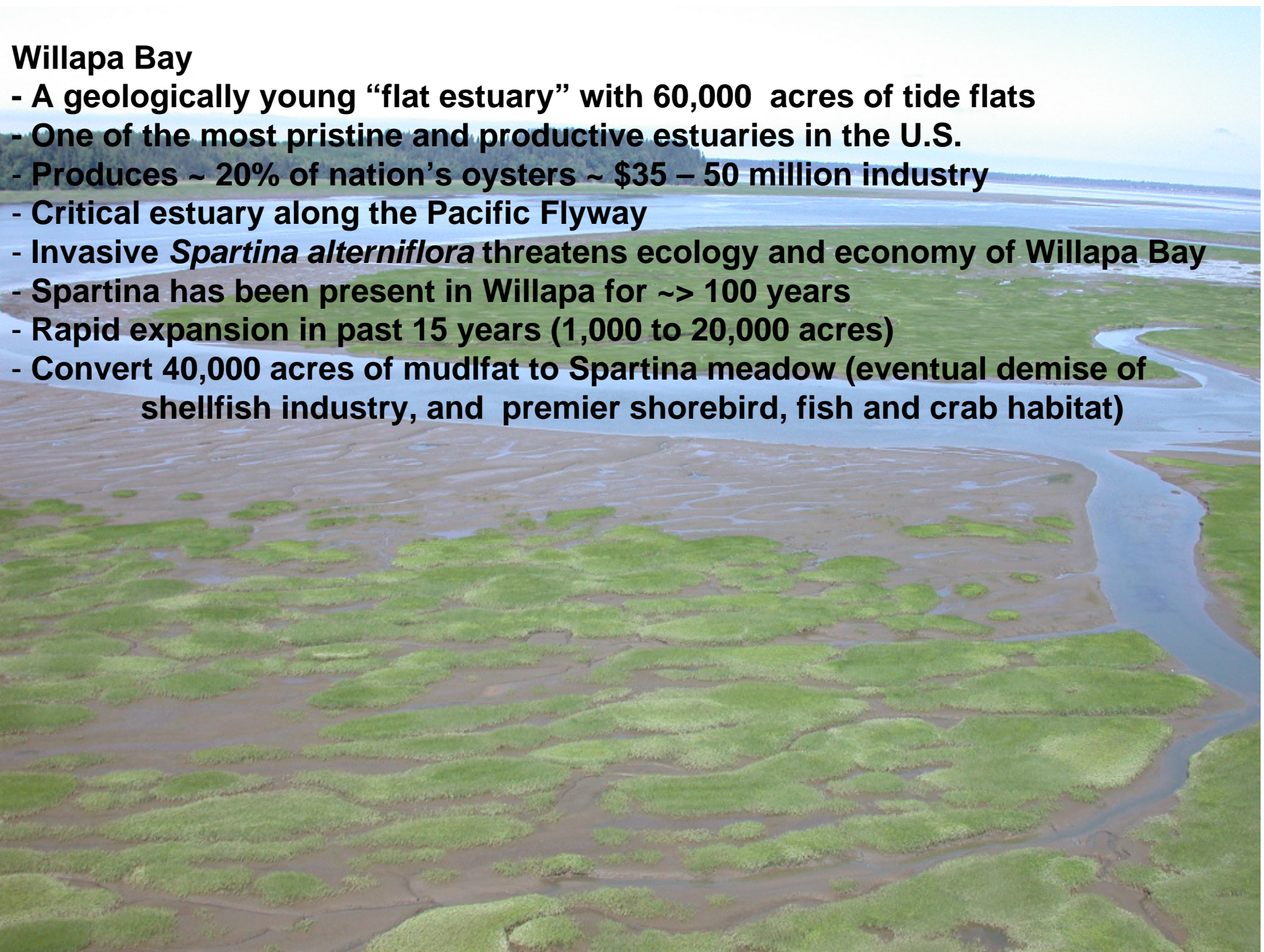
**Ten Year-old Meadow**

Growth rate ( $\text{m}^2$ ) of clones = 30% increase per year



## Willapa Bay

- A geologically young “flat estuary” with 60,000 acres of tide flats
- One of the most pristine and productive estuaries in the U.S.
- Produces ~ 20% of nation’s oysters ~ \$35 – 50 million industry
- Critical estuary along the Pacific Flyway
- Invasive *Spartina alterniflora* threatens ecology and economy of Willapa Bay
- *Spartina* has been present in Willapa for ~> 100 years
- Rapid expansion in past 15 years (1,000 to 20,00 acres)
- Convert 40,000 acres of mudflat to *Spartina* meadow (eventual demise of shellfish industry, and premier shorebird, fish and crab habitat)



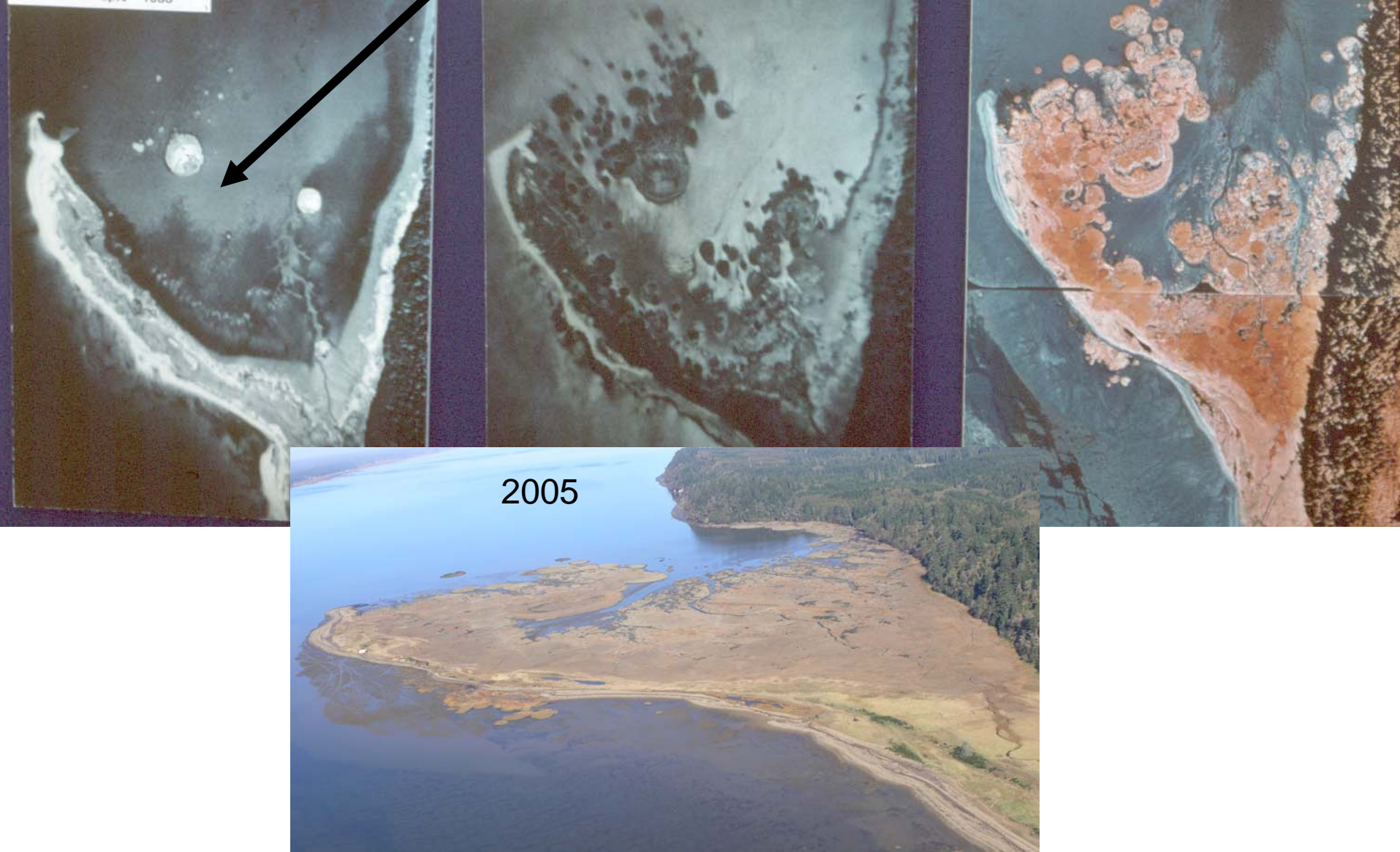


# Jensen Spit – a founding *Spartina* clone

1955

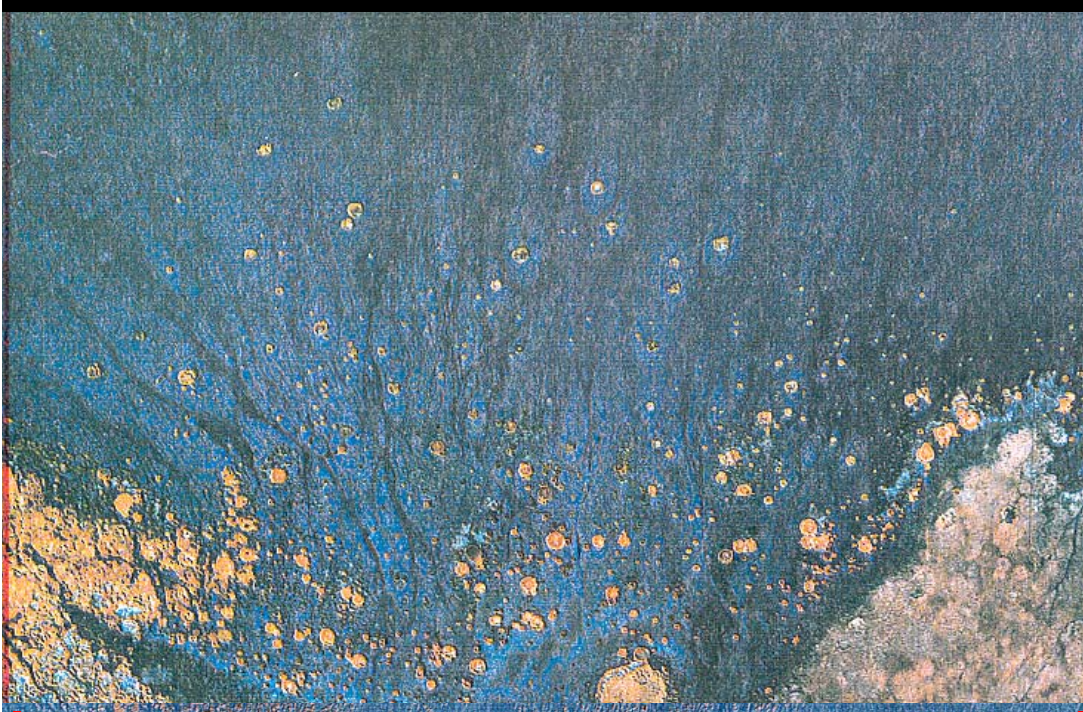
1978

1997

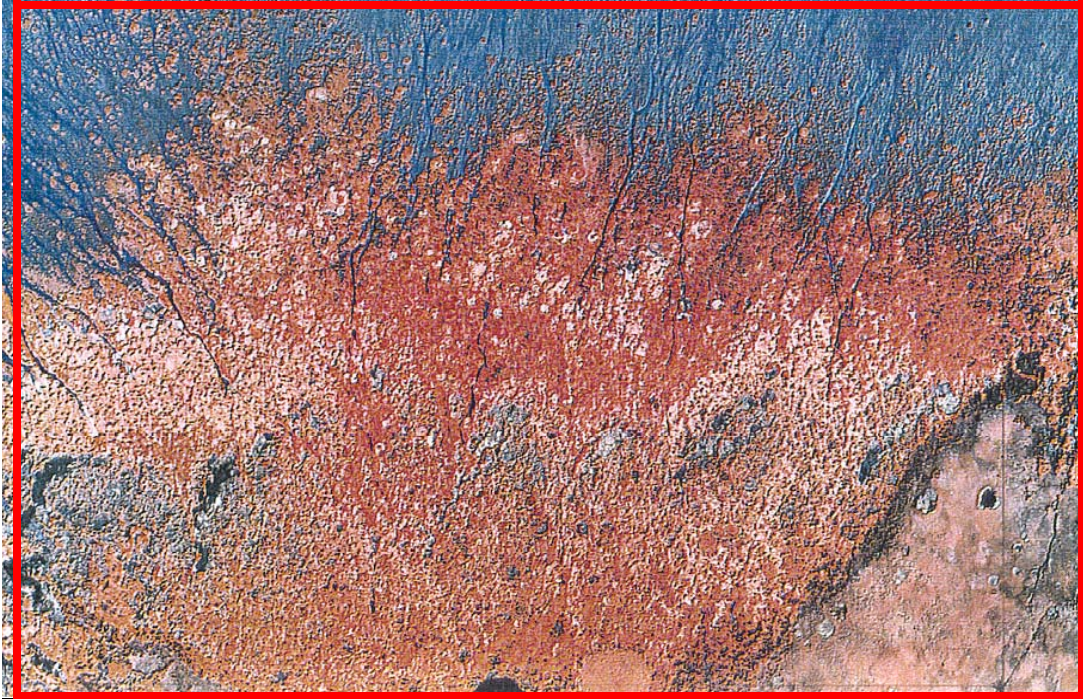


2005





Spartina expansion  
1993 to 1997  
South par of  
Willapa Bay



Aerial photos courtesy of Washington State DNR



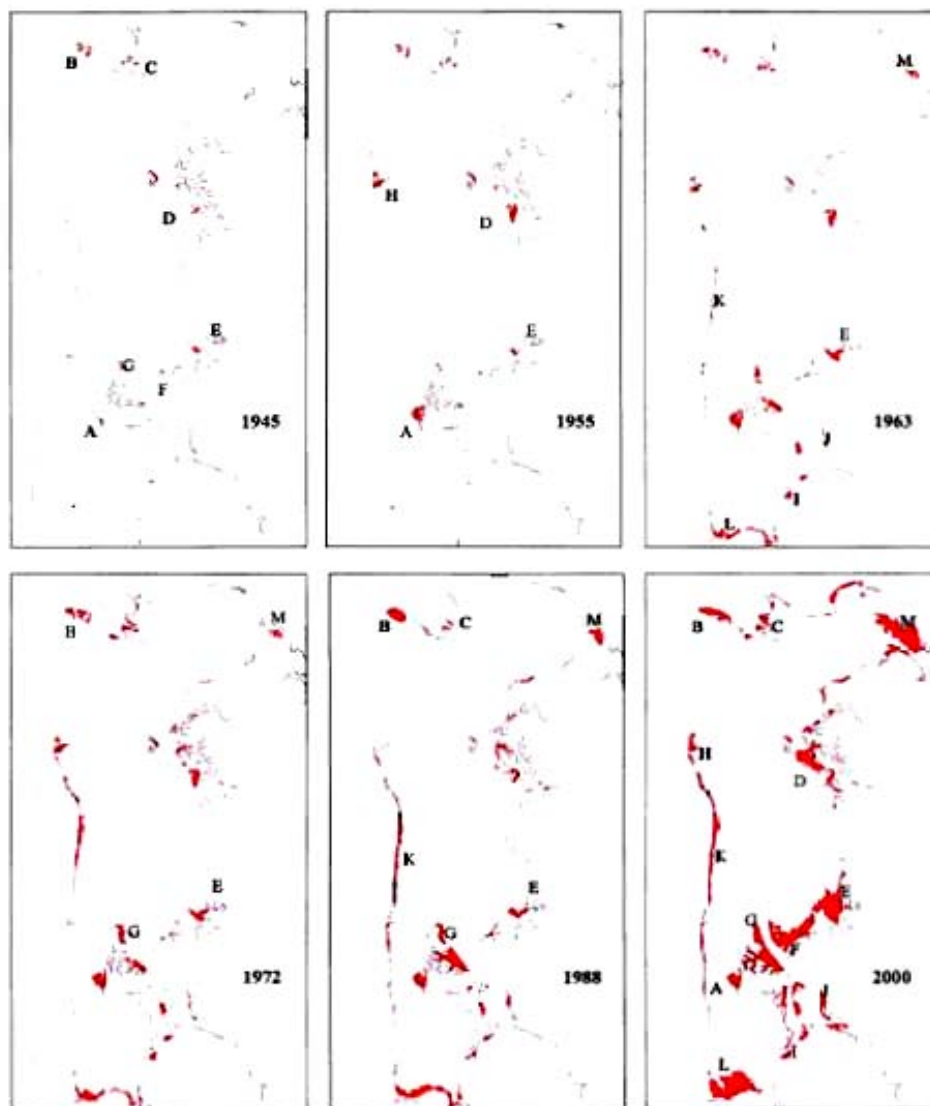
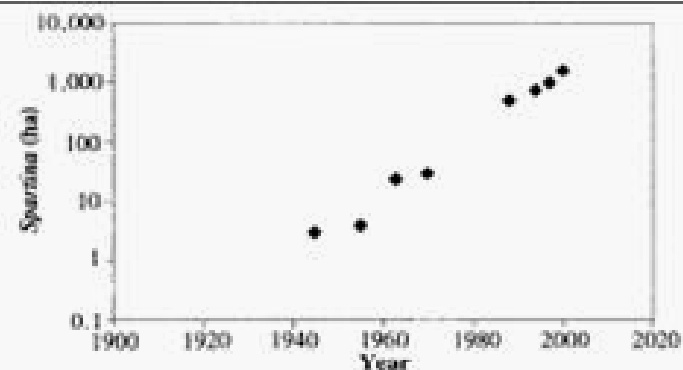


FIGURE 2. *Spartina alterniflora* distribution and abundance between 1945 and 2000. Photographic and GIS data for the years 1945, 1955, 1963, 1972, 1988, and 2000 are illustrated; locations and place names for each year are as follows: A. Jensen Spit; B. North Cove; C. Kindred Slough; D. Pulla River; E. Nemah River; F. Seal Slough; G. Long Island; H. Leadbetter Point; I. Wildlife Refuge Headquarters; J. Nuville River; K. Long Beach Peninsula; L. Porter Point; M. Johnson Slough.

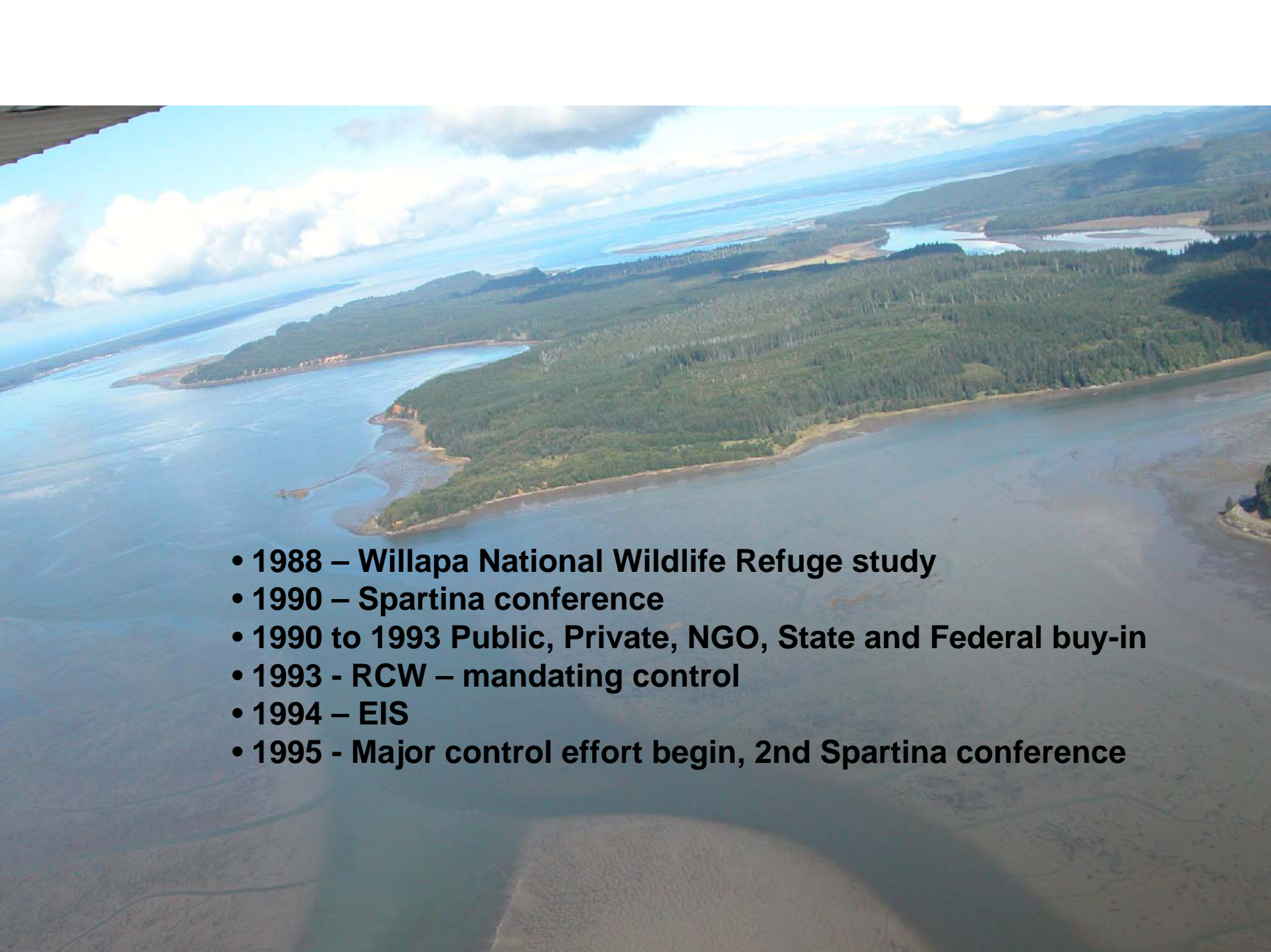


It was just a matter of time before *Spartina* covered every inch of available mudflat (40,000 acres).








- 
- 1988 – Willapa National Wildlife Refuge study
  - 1990 – Spartina conference
  - 1990 to 1993 Public, Private, NGO, State and Federal buy-in
  - 1993 - RCW – mandating control
  - 1994 – EIS
  - 1995 - Major control effort begin, 2nd Spartina conference





**Between 1995 & 2003 >\$10 M has been used for Spartina control in Willapa Bay.  
Those efforts have included:**

- Mowing
- Covering
- Digging
- Crushing
- Disking
- Tilling
- Biocontrol
- Spraying – glyphosate
- Crushing + spraying



Untreated Meadow





Crushing



Covering



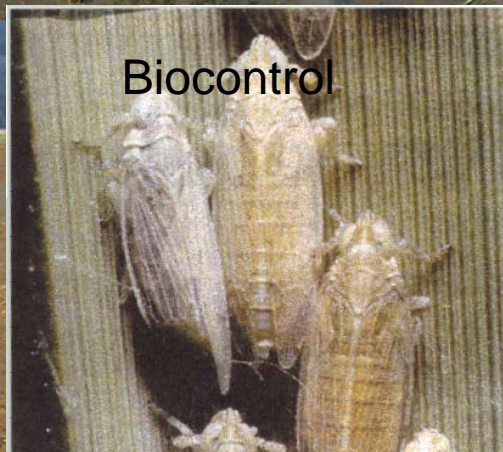
Pulling



Tilling



Biocontrol



Spraying



Disking



Mowing







STAN THOMPSON photo

gs are here. *Prokelesia marginata*, a tiny insect with a big thirst for spartina juice, arrived at a h facility on Pioneer Road in Long Beach last Tuesday for the final steps before planned release Willapa Bay's spartina-infested tidflats. Above, two *Prokelesia* pose on the nose of Dr. Kim Patten.

# Mighty bug to the rescue

By MARA HANDY  
Observer staff writer

PIONEER ROAD—Spartina bugs, called *Prokelesia marginata*, are settling down to their new summer home in cages in the spartina greenhouse.

"They're just as horny as can be and having fun in their new cages," said Kim Patten, associate professor at WSU Long Beach. The bugs arrived on Tuesday, June 20.

The mesh cages contain spartina for the bugs to feed on. "By the end of summer we should see dead

going to rear them for about one generation," said Fritz Grevstad, the scientist on the project. One generation for the spartina bugs is about a month or a month and a half.

This is the last hoop researchers must jump through before the spartina bugs are let out into Willapa Bay—to kill some, or most, of the spartina.

The bugs are a hope for controlling the grass called spartina which is eating up Willapa Bay. It threatens oyster beds, takes over habitat for migratory birds, traps sediment, and causes environmental problems.













Tilling







A photograph of a wetland or marsh area. In the foreground, there is a wide, muddy path with deep, parallel tracks from a vehicle, likely a tractor or heavy truck. The mud is dark brown and appears wet. To the left of the path, there is a patch of green vegetation, possibly grass or reeds, growing in shallow water. In the background, the path continues towards a line of trees and a body of water under a clear blue sky. The word "Disking" is overlaid in white text on the muddy path.

**Disking**







# Roller Crushing









**Crushing with tracked vehicle in soft sediment**









Crushing / pulverizing











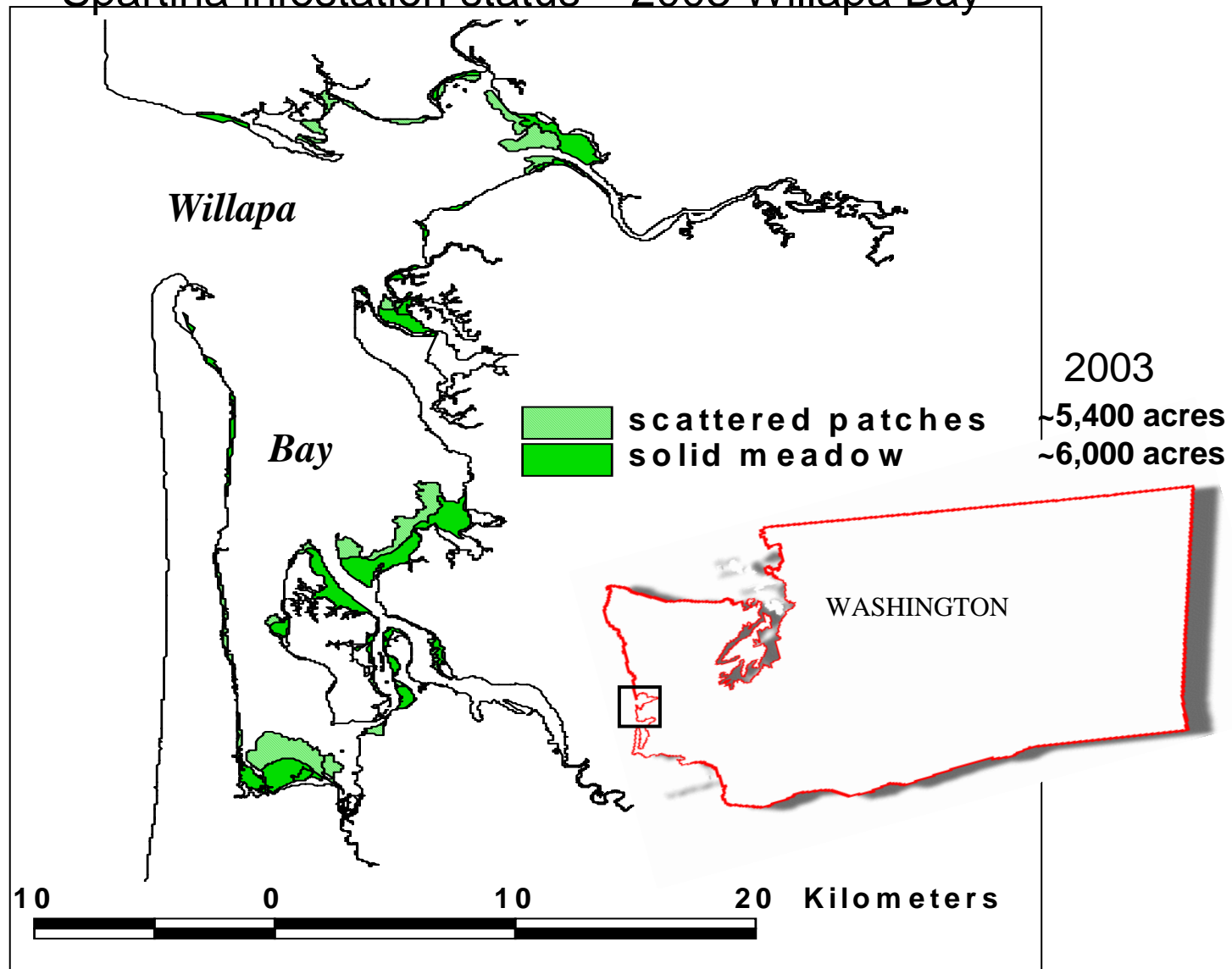


Herbicide



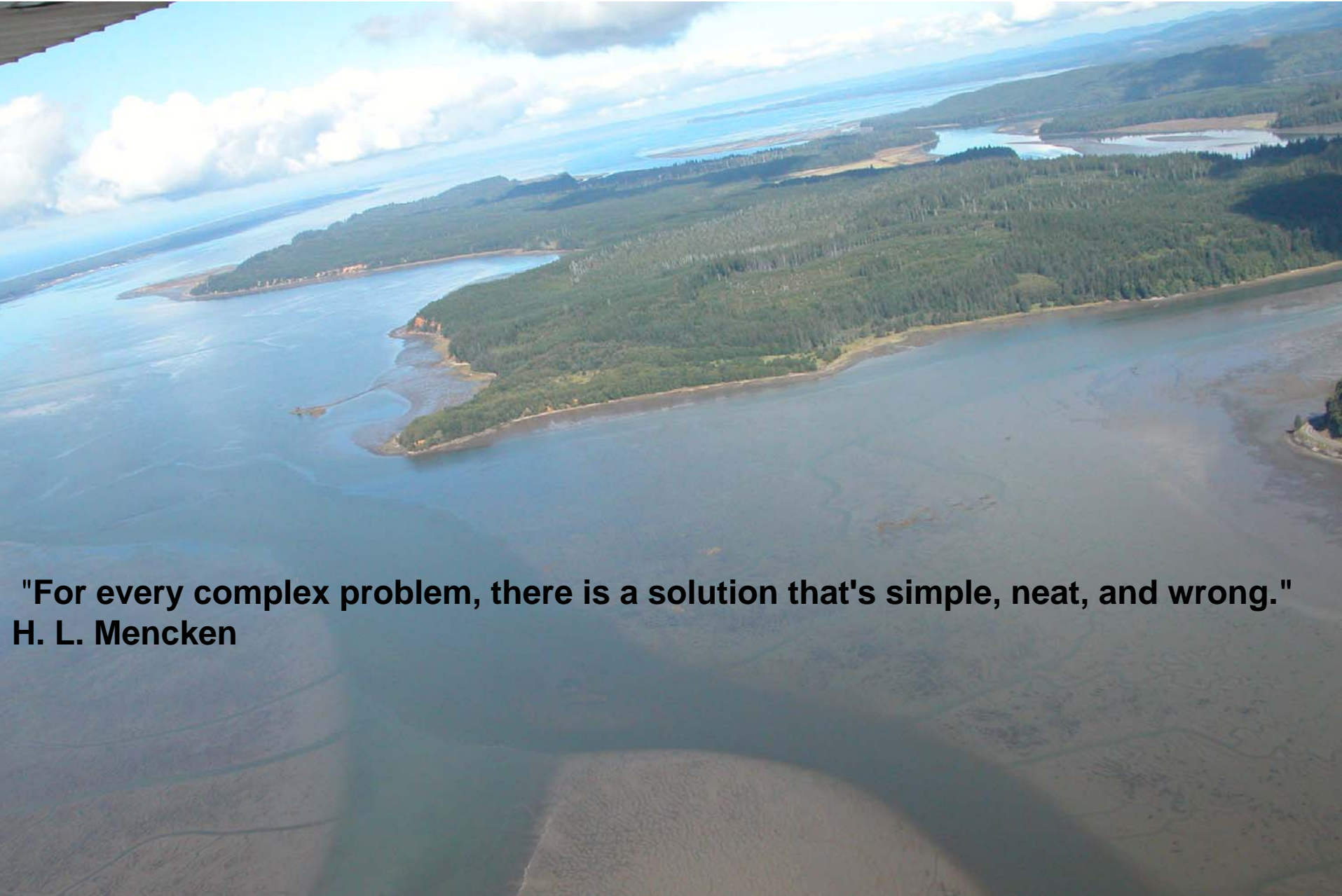


## Spartina infestation status – 2003 Willapa Bay



**Despite these massive efforts, Spartina expanded pretty much unabated (acres infested increased 1995 to 2003~ 3 to 5 fold)**






**"For every complex problem, there is a solution that's simple, neat, and wrong."  
H. L. Mencken**



# Current and projected Status

- 2004– Habitat labeled, large scale chemical control begins
- 2005 to 2007 – large scale control effort continues ~ 600 to 1000 acres left
- 2008 – all remaining patches (large and small) treated
- 2009 Declare Class A noxious weed – mandating eradication, cleanup of outliers
- 2010 to 2012 cleanup of outliers
- 2013 to 2017 monitoring and follow-up to verify eradication



An aerial photograph showing a white and red helicopter flying over a marshy landscape. The helicopter is positioned in the center-right of the frame, moving from left to right. It is spraying a fine mist or chemical over a patch of green and brown vegetation. To the left of the helicopter is a calm body of water, which reflects the helicopter and the surrounding terrain. The landscape is a mix of green grass and brown, possibly dried or treated, vegetation. The overall scene suggests a conservation or agricultural activity, such as pest control or habitat management.

Habitat label received in 2004

~5000 acres treated in 2004

~6000 acres treated in 2005

~5000 acres treated in 2006

~4000 acres treated in 2007



# Naselle River tide flats

2006



2000





Photo Sept 2005

700 acres Spartina meadow

July 2004 -6 pt/ac Habitat 10m gpa aerial

July 2005 6pt/ac Habitat 3% Rodeo 60 gpa amphibious boom sprayer

Control 98%+







Photo October 2005

500 acre Spartina meadow

2004 -6 pt/ac Habitat 10m gpa aerial

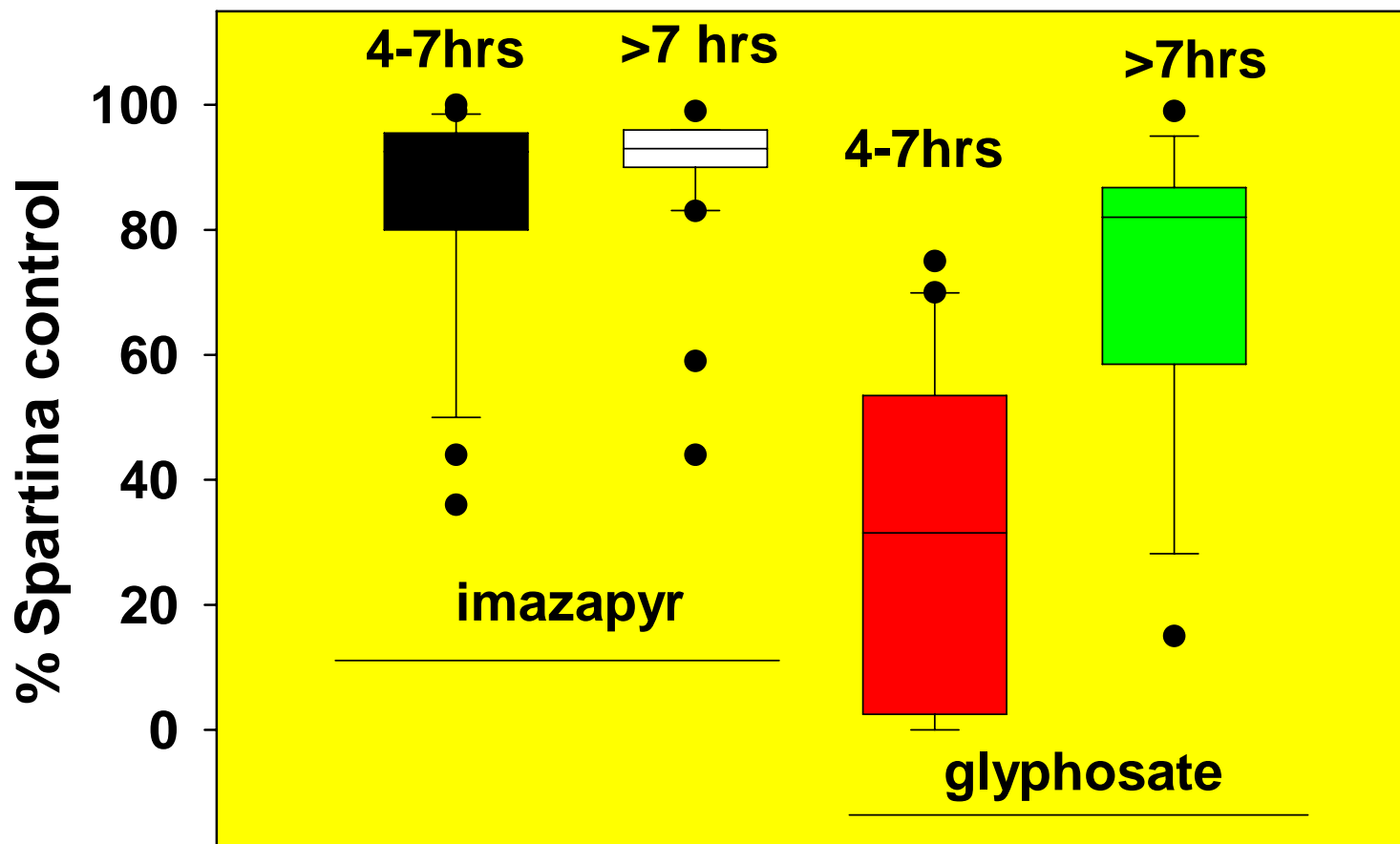
2005 6pt/ac Habitat 3% Rodeo 60 gpa amphibious boom sprayer

2006 to 2007 clean up of outliers with tank mix of Habitate & Rodeo



- **Thanks to the large scale use of herbicides we will shortly achieve success and be *Spartina* free**
- **But at what cost to the environment & ecology?**
- **What are the comparative cost to the environment of chemical control to that of losing the battle to *Spartina*?**
- **Research results on:**
  - **Herbicide persistence**
  - **Infauna**
  - **Native marsh species**
  - **Fish**
  - **Shorebirds**

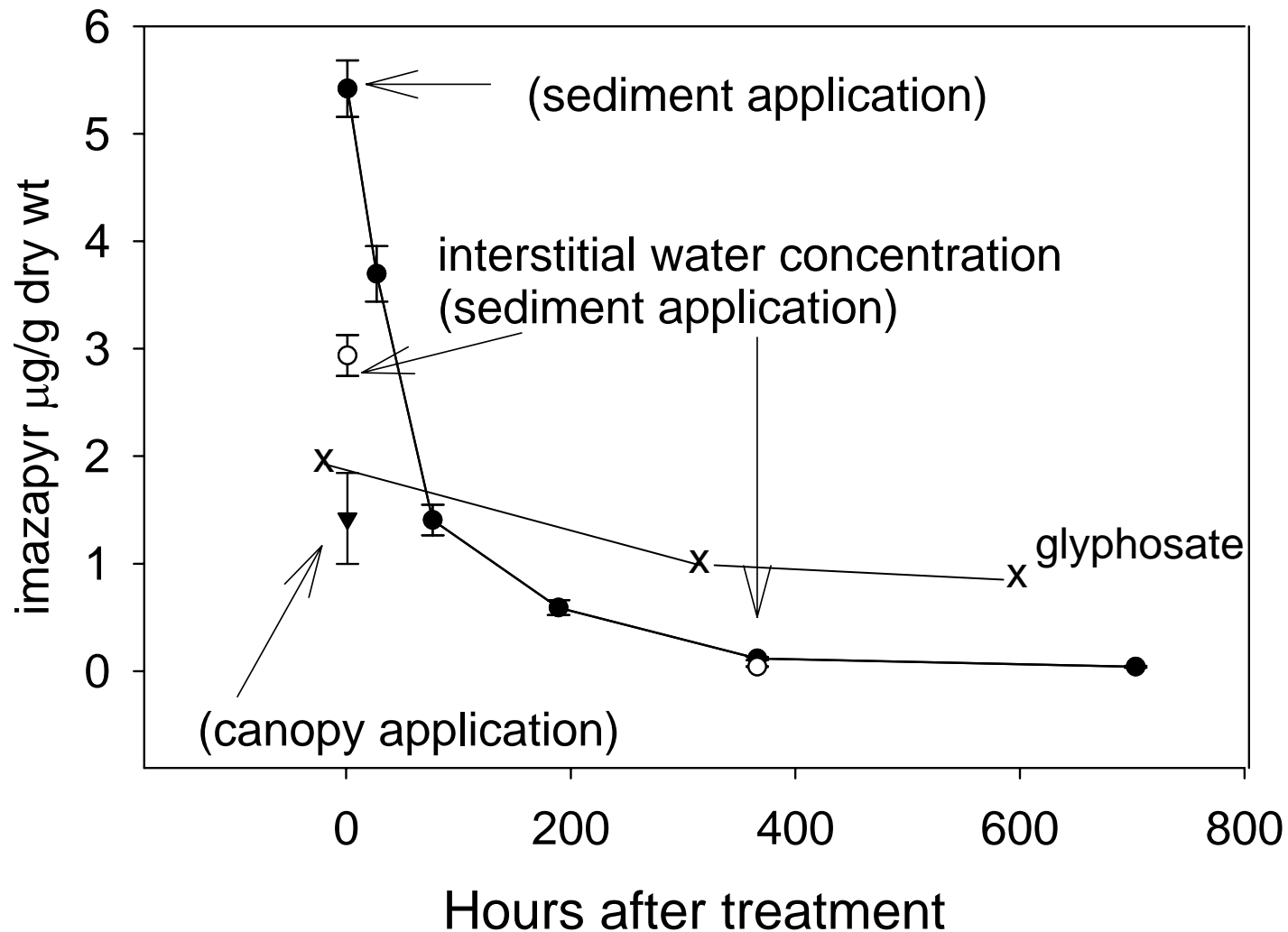




**Efficacy comparison for 1.68 kg/ha imazapyr and 8.4 kg/ha glyphosate as a function of dry times\***



# Herbicide persistence in the mudflat sediment

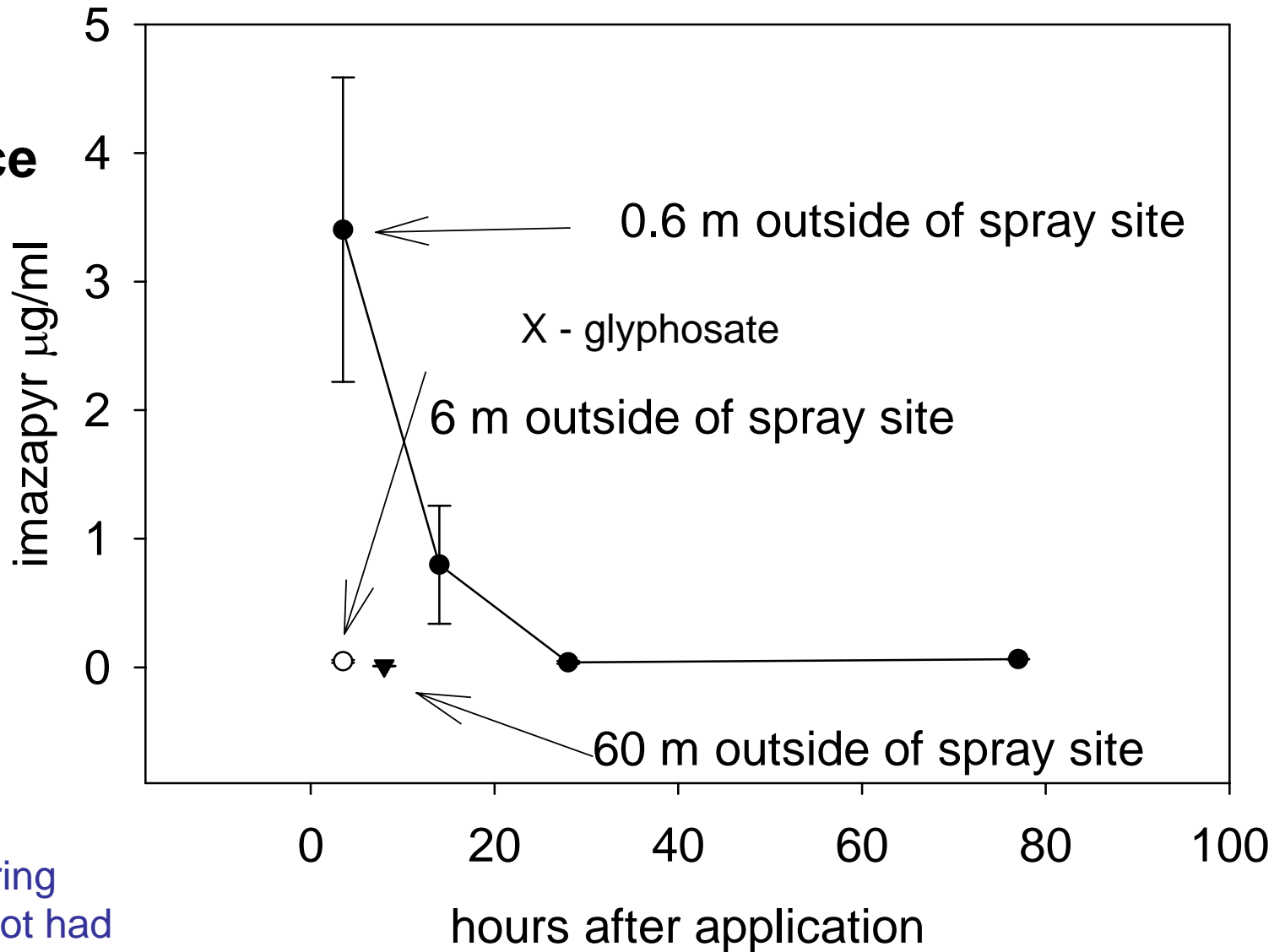


Imazapyr persistence in estuarine sediment

X = glyphosate persistence (Paveglio et al. 96)



# Herbicide persistence in the tidal water



X – glyphosate (Paveglio et al. 1996)

Water monitoring  
by state has not had  
any detect of imazapyr  
In 3 years of large  
scale spraying



Toxicity of these herbicides to fish is a huge concern.

Five years of research to address this concern

Chris Grue et al.

School of Aquatic and Fishery Sciences

Washington Cooperative Fish

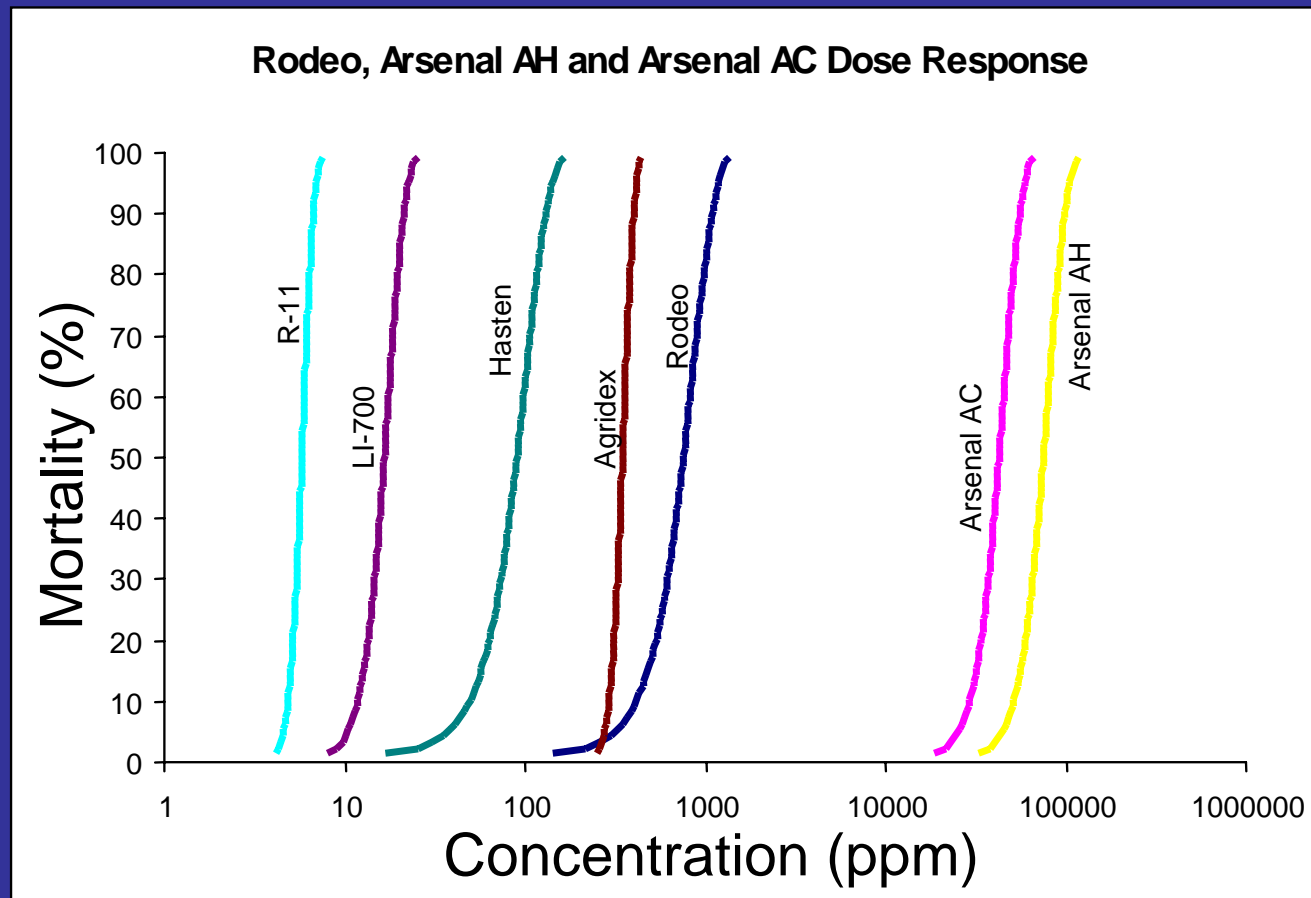
and Wildlife Research Unit

University of Washington



# DOSE RESPONSE CURVES

## Rainbow Trout





What about combined effects of herbicide + surfactant?

	LC50 (ppm) for Rainbow trout
Rodeo	782
Rodeo + R-11	5
Habitat	77,716
Habitat + Agridex	479



## Surfactant drives the toxicity

Surfactant	Acute toxicity to rainbow trout ( mg/l LC 50) (96 hrs)	Acute toxicity to Daphia spp. (mg/l LC 50 (48 hrs)
Agri-Dex	>1000	377
Class Act Nx Generation	447	60
LI-700	130	170
Competitor	95	>100
Dyne-Amic	23	60
Kinetic	14	61
R-11	4	19
Sinker	750	>1000
Bond	190	614
Tactic	>100	310
Magnify	>100	8
Exciter	>100	8
Intensify	>100	8
Cygnets Plus	45	7
Liberate	18	9
R-11	4	19



- Data not convincing enough?
  - What about fish behavior?
  - What about salmon?
  - What about synergy – we are spraying four different chemical together?
    - Imazapyr
    - Glyphosate
    - Surfactant (competitor)
    - Blue marker dye



- New studies with complete tank mixes on Juvenile Chinook looking at behavior & smoltification.
  - Fish exposed at equivalent rate that would occur if tank mix was applied at full maximum rate to 10 mm of water depth
    - 6 hours exposure following by 18 hours of flushing repeated 3 times
  - No effect on mortality, behavior or smoltification



- What about long term impacts on benthic infauna?
  - Two studies comparing native mudflat to control *Spartina* meadow



# Benthic infauna density 0 to 5 cm depth in the winter 2004

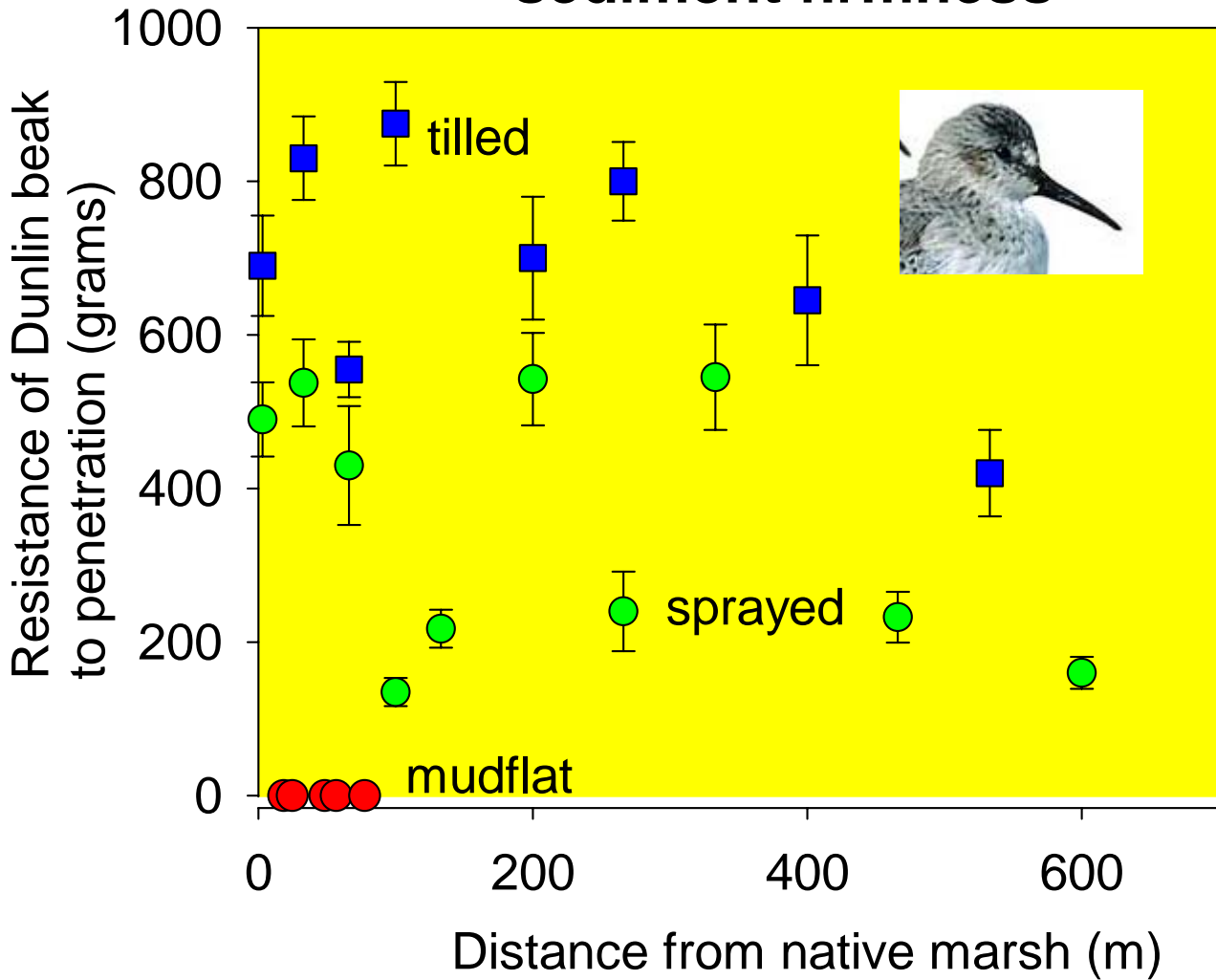
Treatment	Bivalves	Polychetes	Nematodes	Gastropods	Amphipods and isopods	Dipteran larvae,	Others
	#/78 cm <sup>2</sup>						
Bare Mud	45	0.5	4.3	0	2.7	0	0
<i>Spartina</i>	0.1	0.3	1.3	0	0.1	0.1	0
Sprayed	0	16	0.1	0	0	0	0
Tilled	0	0.2	0.6	0.1	0.1	0.2	0.1







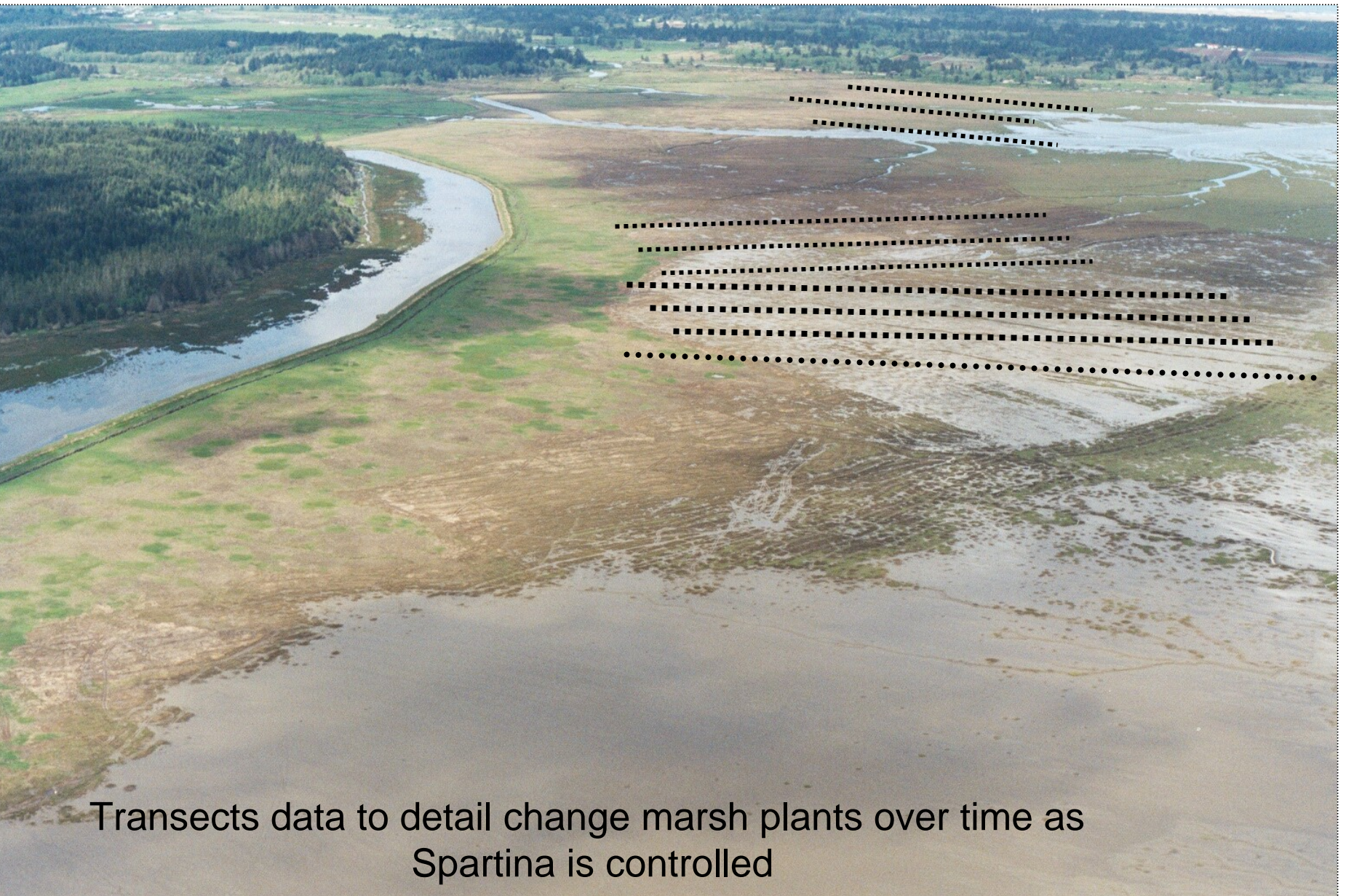
# Food accessibility as a function of sediment firmness





- What about native marsh species?
  - Longitudinal study of treated meadow





Transects data to detail change marsh plants over time as  
Spartina is controlled



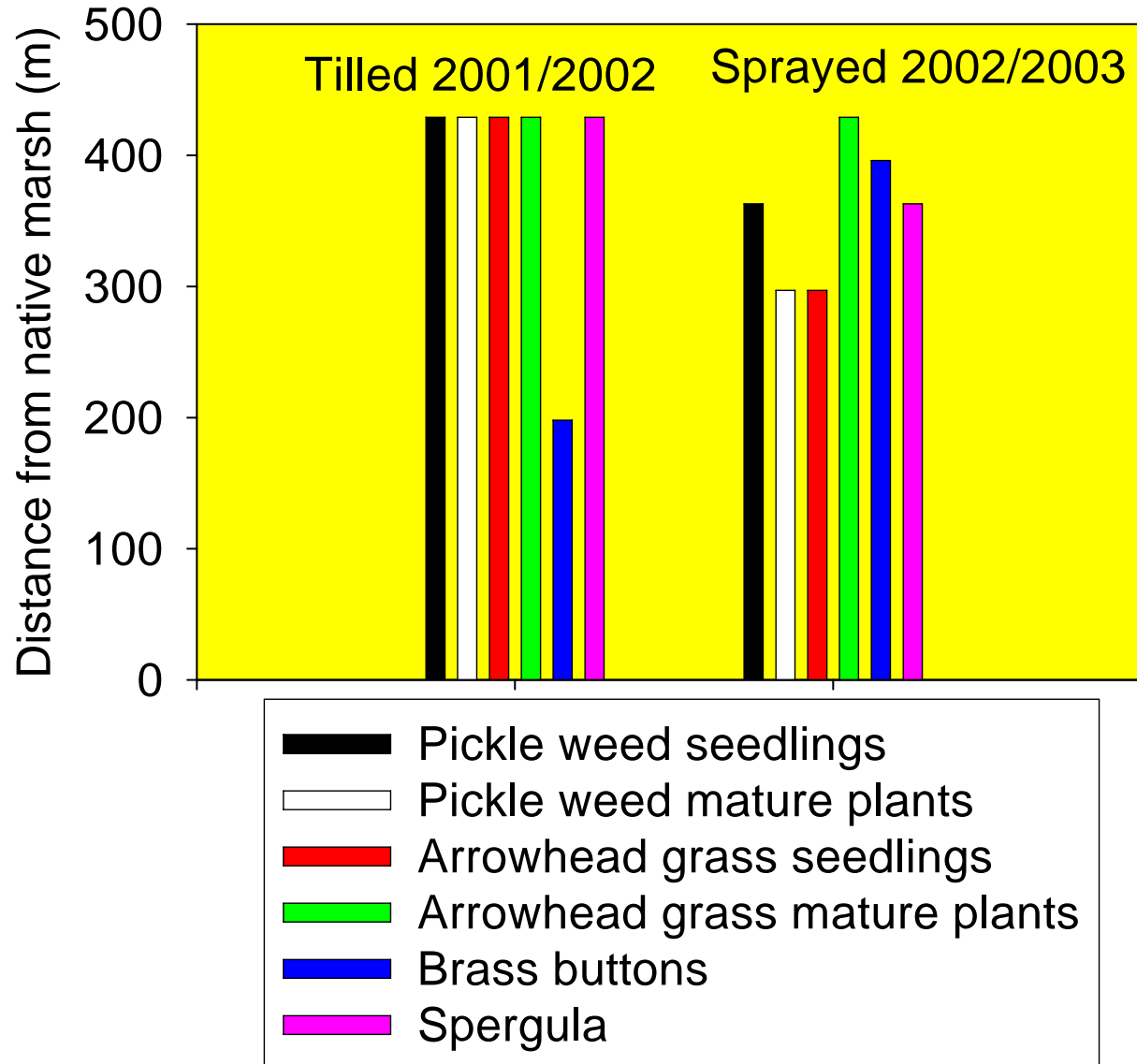








# Mudflats to Marsh - native plant transition 2004





What about shorebird usage

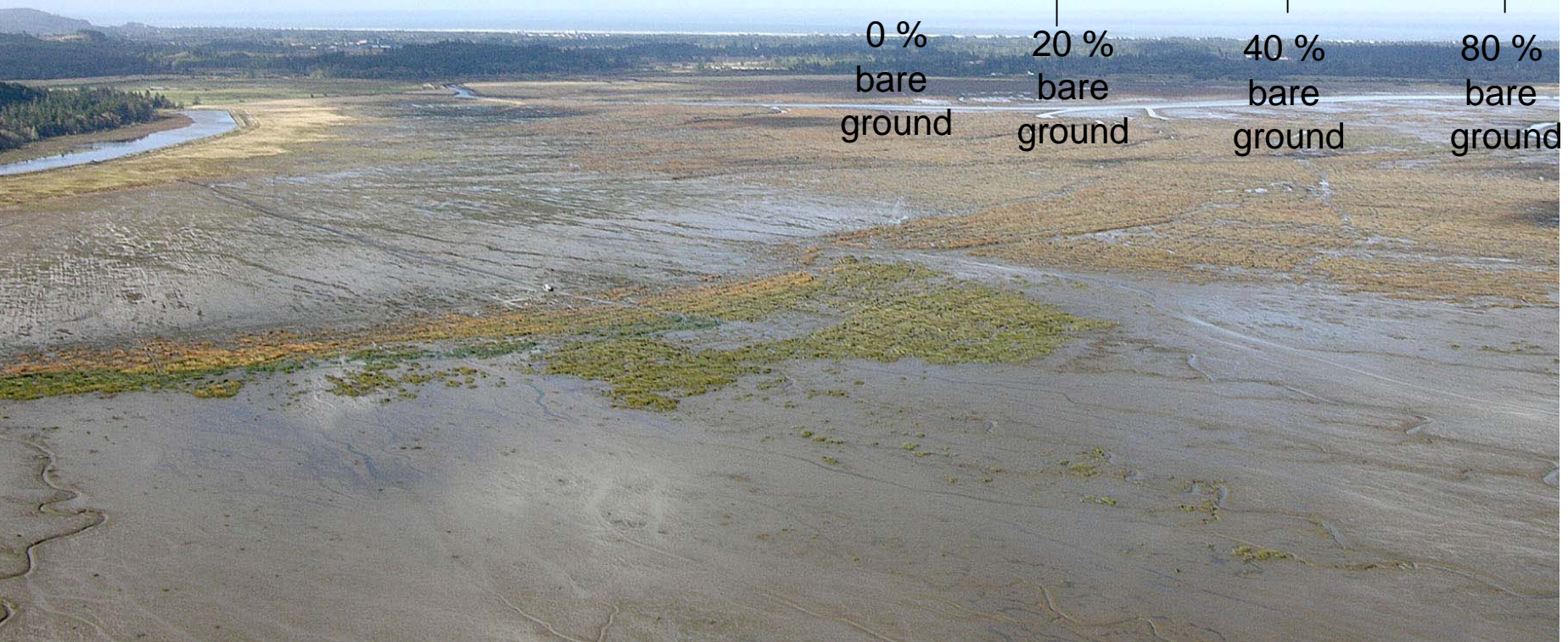
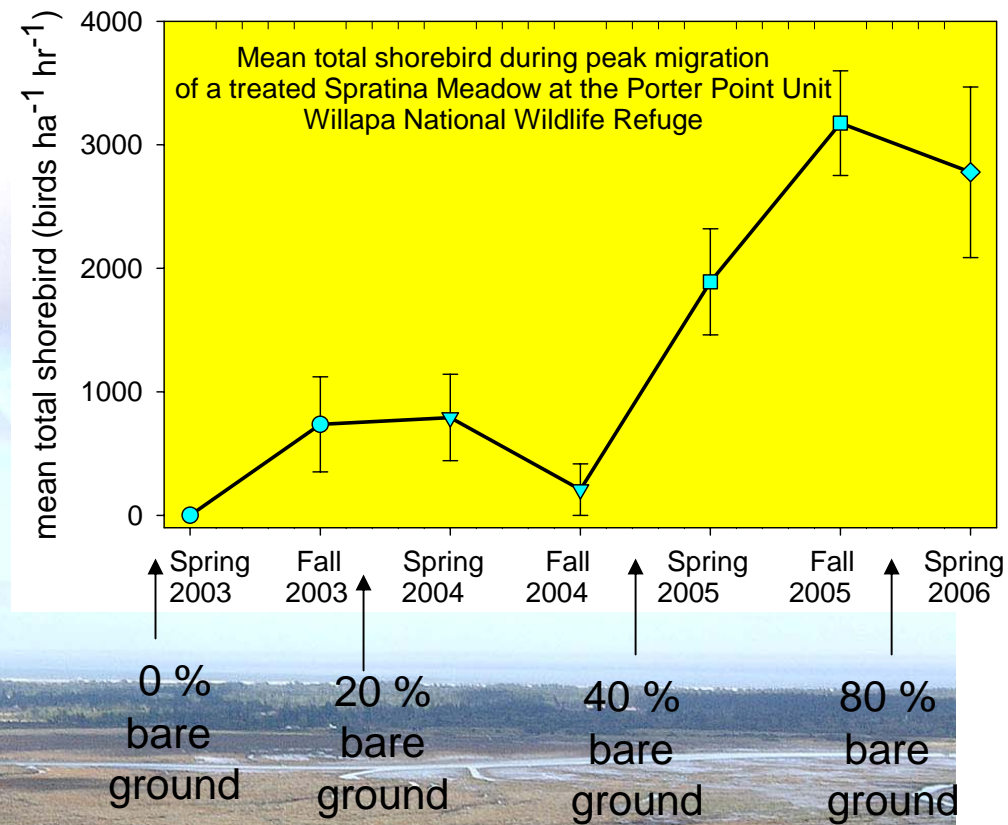


Four years of monitoring  
during peak migration





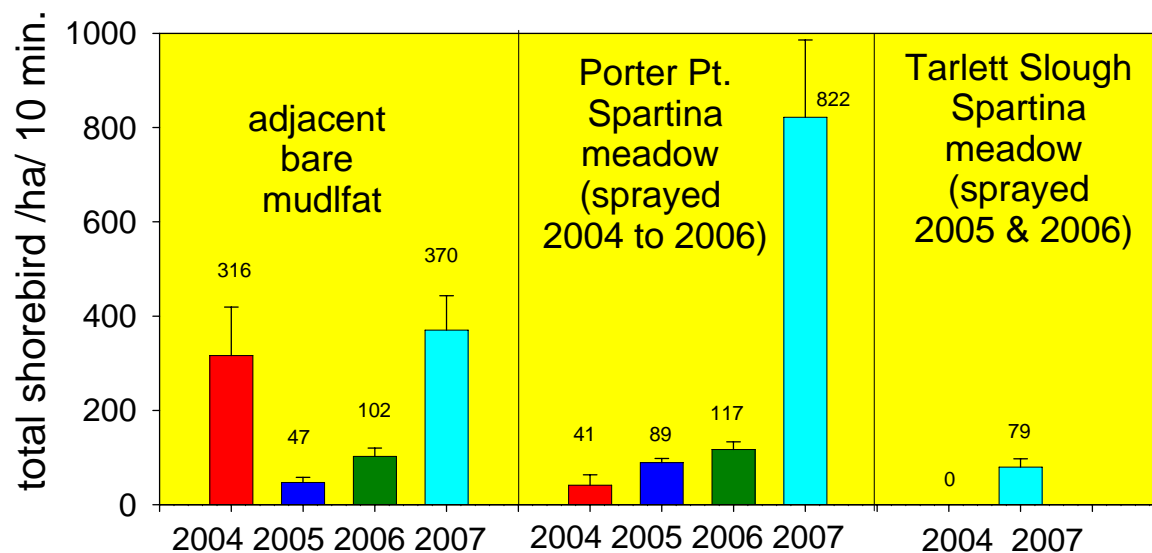
Porter Point, 3000 solid acres  
Tilled 2001  
Treated with Rodeo in 2002 and 2003  
Treated with Habitat in 2004 and 2005  
Control inconsistent ~ 85%,  
a lot of cleanup required  
Marked increase in Shorebird usage  
of treated areas





# Total Shorebirds During Spring Migration Porter Pt. Unit, Willapa National Wildlife Refuge

## Change in foraging density following Spartina control



Data reflect increase in usage of prime shorebird habitat following control of Spartina.

The Porter Point meadow treated in 2004 to 2006 was essentially Spartina free in Spring 2007.

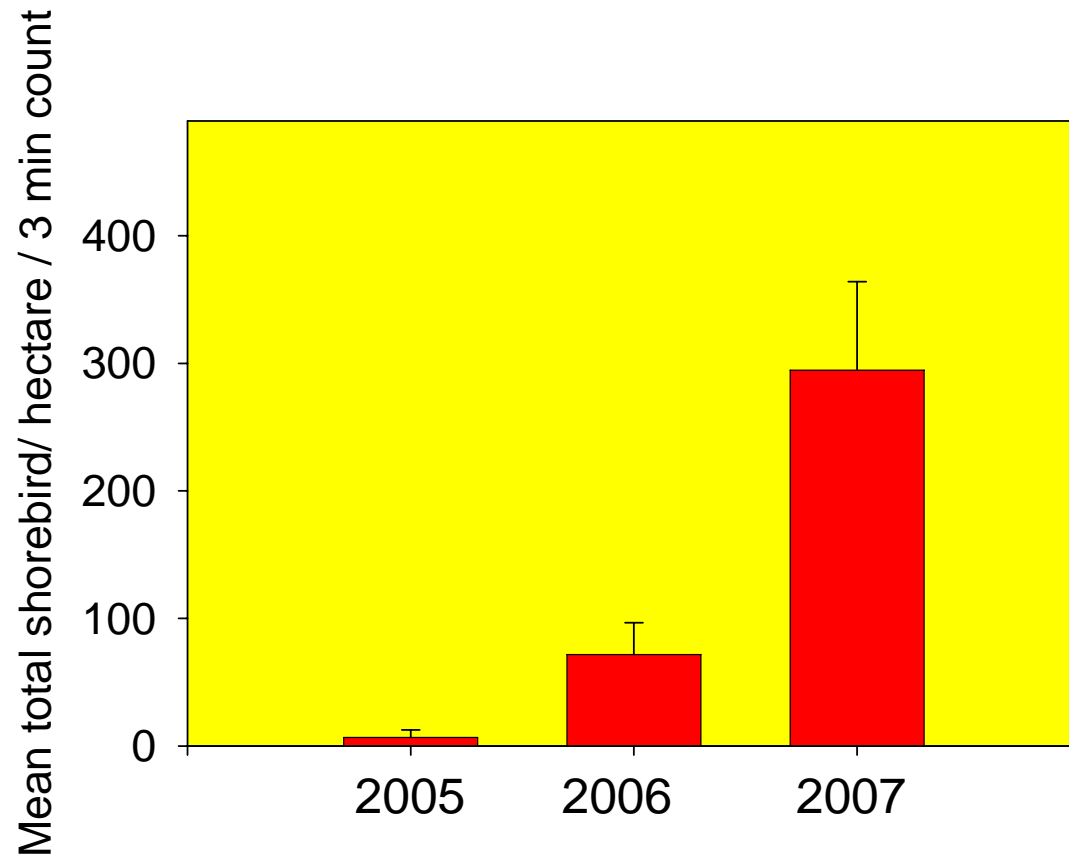
The Tarlett Slough meadow was treated in 2005 & 2006 was ~ 60 % Spartina free in Spring 2007. This meadow had zero bird usage in 2004.

Study conducted by WSU Long Beach

Bars = mean shorebird (all species) with standard error



# Mean Spring Migration Shorebirds @ Palix River mudflat following Spartina Control



Palix River meadow was ~ 600 acre of solid Spartina.  
The meadow was treated with imazapyr by air in fall 2004,  
boom sprayed in 2005, and spot sprayed in 2006 and 2007.  
Data collected by Washington State University for the Willapa  
National Wildlife Refuge



## **Summary**

- **Success was only made possible when we obtained effective chemical control**
- **The ecological impact of using chemical control did not appear to be significant**
- **The ecological benefit of eradicating Spartina in Willapa was immediate and highly beneficial.**

Questions?

